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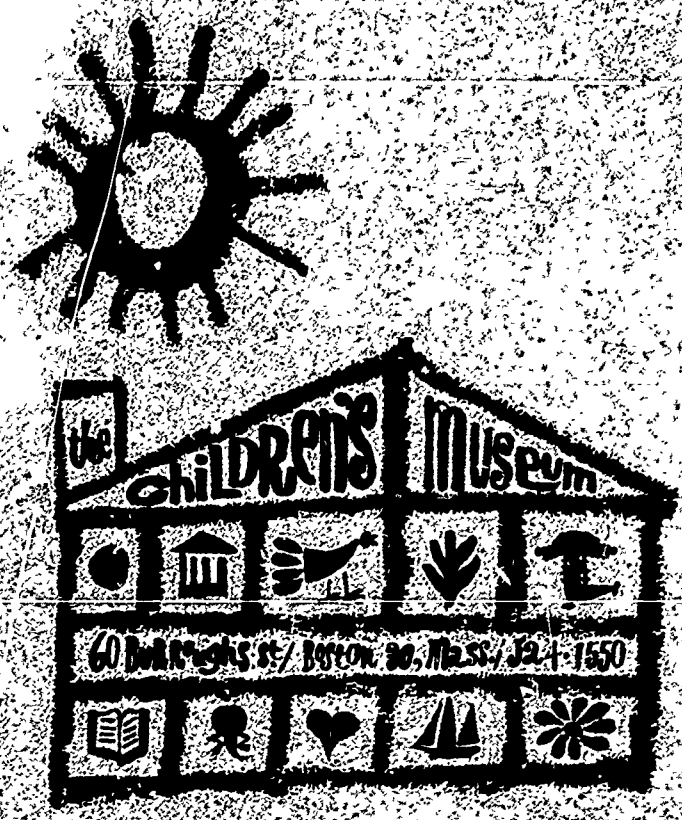
ABSTRACT
The Materials and Activities for Teachers and Children (MATCH Box) project was developed in 1965 to provide for the relatively intensive treatment of a subject over a short period through materials geared to the elementary school level. Each MATCH Box contains materials, equipment, and activities that work together to foster the teaching/learning of specific subjects. ANIMAL CAMOUFLAGE is a series of five, one-hour lessons covering the protective camouflage systems of insects and animals. The MATCH Box contains, among other things, slides and a shadow box with magnetic "animals". The students study the variations in color, shape, and pattern of animal camouflage and learn to consider their results in terms of the particular relationship between the predator, the prey, and the background. The Box contains brief descriptions of each slide to aid class discussion. The Shadow Box helps students to "see" camouflaged animals and they are given the opportunity to construct their own dioramas. (SH)

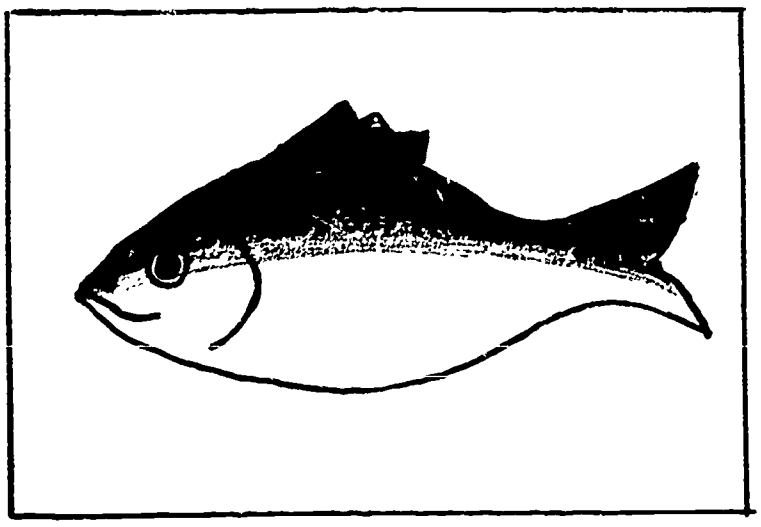


ANIMAL CAMOUFLAGE

THE MATCH BOX PROJECT

Materials and Activities for Teachers and CHildren

The material in this publication was prepared under a contract with the United States Office of Education as authorized under Title VII, Part B, of the National Defense Education Act, 1958.



BY

GILLIAN STANDRING

ROBERT BERNATH

TEACHER'S GUIDE TO

ANIMAL CAMOUFLAGE

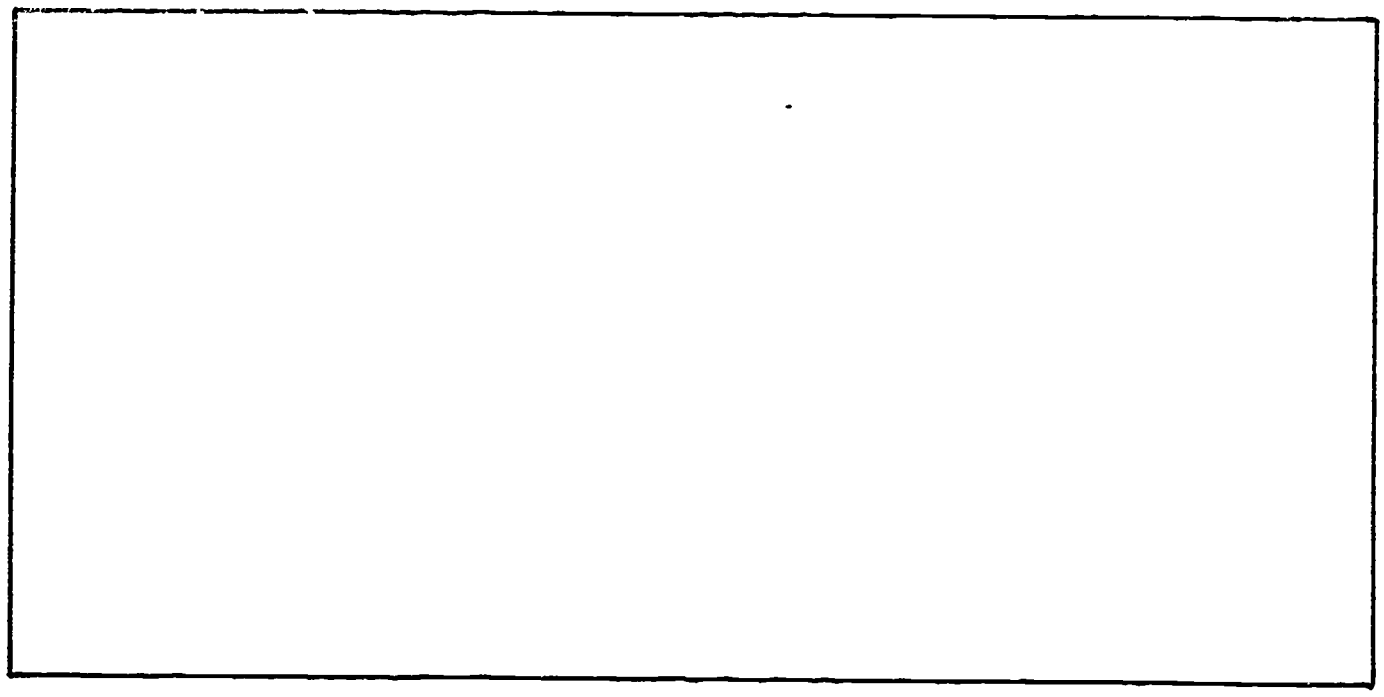
GRADES 2 AND 3

PROTOTYPE EDITION

CONTENTS

WHAT IS CAMOUFLAGE?

The picture below shows a flock of white geese flying over the North Pole in a blizzard, eating saltines.



Background and foreground have merged into one and are totally indistinguishable. If this extreme were possible, the picture would illustrate camouflage at its finest!

Though camouflage in nature can hardly achieve such a state of perfection, good camouflage does depend on a specific set of relationships between an object, its background, and the viewer. Camouflage does not exist in an animal by itself, nor in the background, nor in the sensory limitations of the hunter, but when a particular pattern of relationships exists, an animal survives which would otherwise have been detected and attacked.

There are several techniques of camouflage, some of which are described later in this introduction. The lessons in the Box emphasize only a few particularly common camouflage techniques: (1) color matching, (2) pattern matching between the animal and its background, (3) countershading, and (4) disruptive patterning to obscure the outline of the animal.

Camouflage exists when a certain combination of color, pattern, texture and form makes it difficult

to detect or recognize the identity of an object. Among animals it serves as a protection from the hunter's keen eye. In other cases, it serves to conceal an animal as it hunts its prey. Camouflage in nature is not perfect. It cannot make an animal completely invisible, but it does give both predators and prey a better chance in the struggle for survival.

The camouflage relationship is not a static thing. Animals and their backgrounds change, and the alertness of a predator is not constant. For instance, arctic animals change the color of their coats according to the season so that they remain camouflaged throughout the year. Many animals, particularly insects and birds, show marked changes in color and pattern during their life cycles so that each life stage blends into its own particular environment. A few animals, such as the chameleons, show rapid color changes when they move from one background color to another.

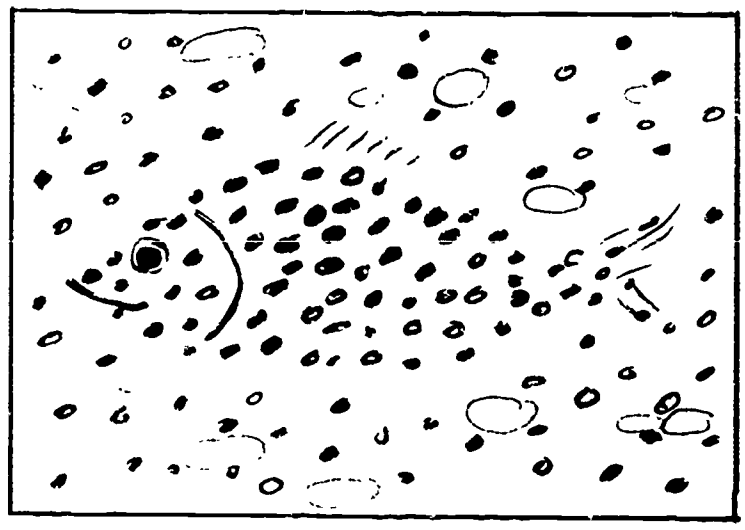
Many predatory (hunting) animals, particularly mammals, do not see in color, but in black and white and various shades of grey. Other animals, notably insects, see colors outside the parts of the light spectrum to which the human eye is sensitive. Therefore, an animal that seems to us to blend well into its background does not necessarily become camouflaged from all attackers, and, in turn, we can see animals that would be concealed from some predators. There are other important kinds of camouflage besides those dealing with color.

Camouflage is of two main types - concealment and disguise. Concealment means that an animal blends into its surroundings; disguise refers to the special resemblance of an animal to particular objects in its environment. The effectiveness of both is greatly increased if an animal stays quiet and motionless. Hiding behind or underneath an object is not camouflage.

EXAMPLES OF CONCEALMENT

All-Over Patterning

An all-over pattern will help to conceal an animal against a patterned background; the closer the patterns match, the more difficult it will be to see the animal. A good example is the "dead leaf" pattern of the woodcock.

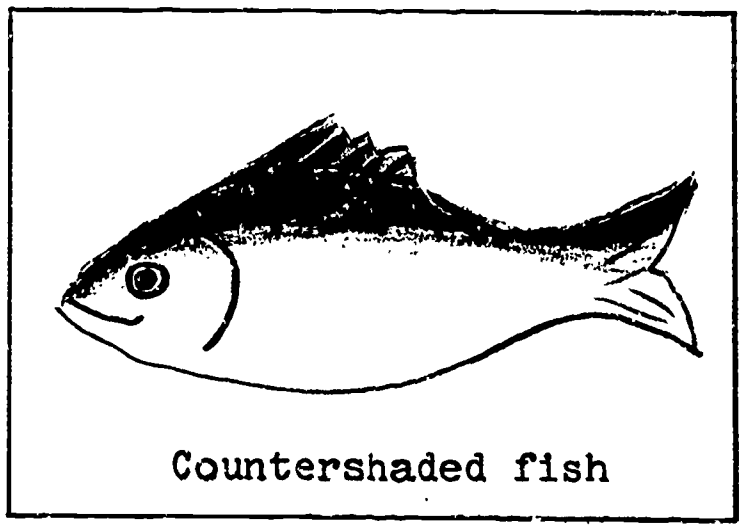


Disruptive Patterning

The specific outline of an animal makes its shape easily recognized by an observer. Thus an important concealment technique is to obscure that outline. Disruptive patterns with maximum contrast between different areas break up the outline and conceal parts, such as eyes and limbs, that are easily recognized. Many snakes and amphibia show this type of concealment.

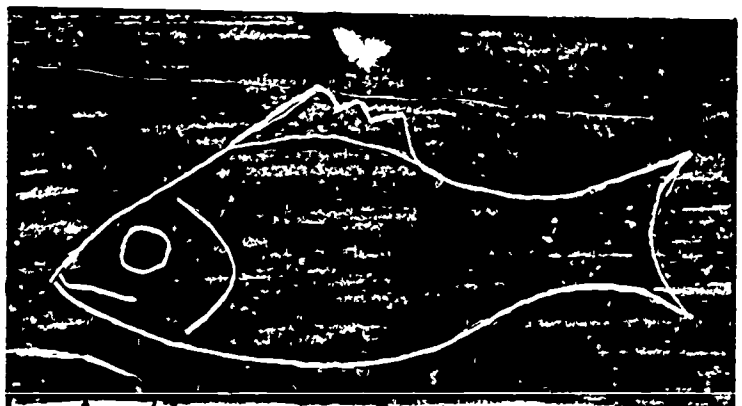
Countershading

An animal may closely resemble its background in color, pattern and texture, but if its underside is in heavy shadow it will not be well concealed. Countershading, a dark back and lighter underside, is found in almost all animals. This balances the shadow created by light from above, making a solid object appear flat.



Countershaded fish

Many animals, such as moths which rest with wings flat against the bark, or the rabbit which crouches close to the ground, also have special shapes or behavior which help to hide tell-tale shadows on the ground.

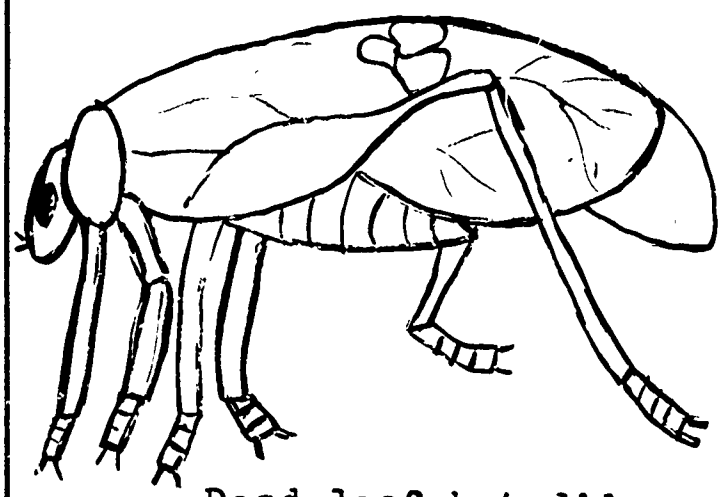


As the same fish appears when lit from above

EXAMPLES OF DISGUISE

The disguise of some animals may make them appear to be a part of the plant on which they live, or some other object in the environment, or it may take the form of mimicry of a more dangerous and unpleasant animal which would be left alone by a predator. Sometimes special adaptive behavior and attention-diverting marks also form part of the disguise, as in the case of many insects which show extreme reluctance to move and reveal their positions, and the fishes which have conspicuous "eyes" on their tails.

Rose-thorn bug



Dead-leaf katydid

For further information and examples of camouflage you may wish to refer to the bibliography in this Guide and to the slides which are included in the Box.

USING THE BOX

The Box is built around five activities. They are designed to lead the children from an awareness of the scope and problems of camouflage, through an analysis and exploration of some specific techniques to an activity which applies such techniques in camouflaging an object of their own choice.

The lessons are approximately one hour long. As you carry out these activities, others will suggest themselves; we encourage you to follow whatever leads your own interests and those of the children dictate.

LESSON DESCRIPTION

I PREDATORS AND PREY

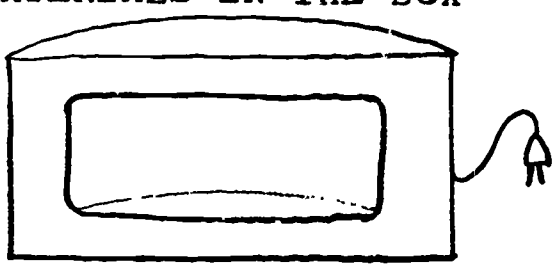
PART 1

This activity is initiated by the teacher, who shows the class a woodland scene in which a number of moths are concealed. From their seats, the children try to discover all the moths in the scene.

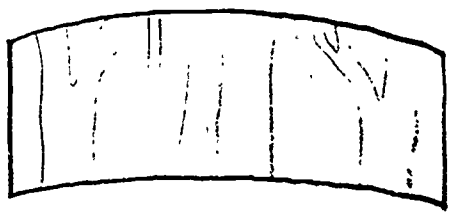
PART 2

In small groups, the children play a game in which they try to discover various animals that have been concealed by another of the groups against the background in the Shadow Box.

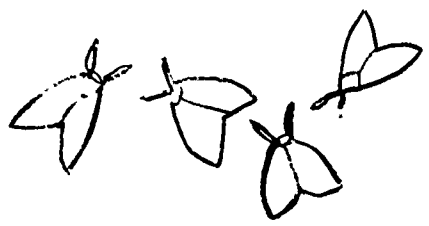
MATERIALS IN THE BOX



Shadow Box



Oak forest background



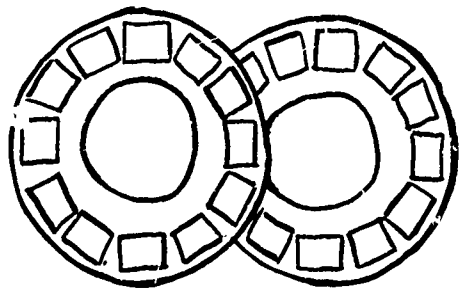
Magnetic moths

Magnetic animals in bag

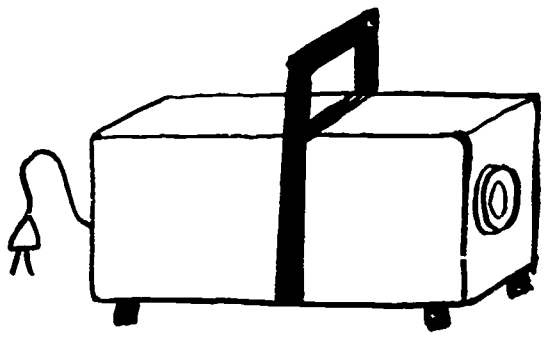
II ALL KINDS OF CAMOUFLAGE

These slides and embedded insects illustrate some examples of animal camouflage. They may be used either as a separate activity or continuously throughout the period of the Box's use, as illustrations and references for specific camouflage techniques. The projector which is included is simple enough for the children to use themselves.

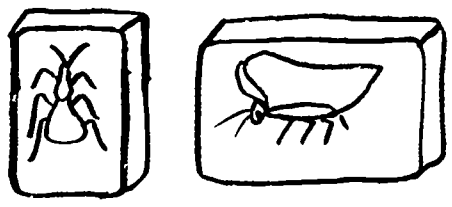
(An extra "under-water" background and magnetic shark model have been included. They could be used as part of this lesson, as another example of camouflage or later in Lesson IV, to demonstrate countershading.)



Two discs holding slides



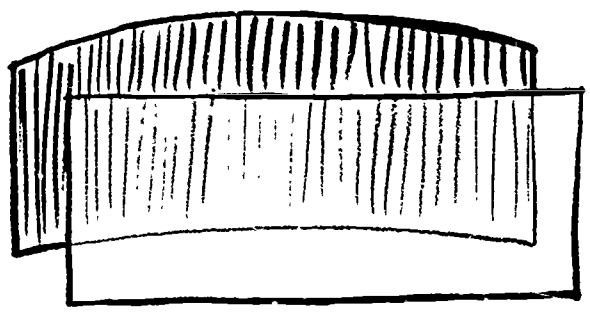
Slide projector



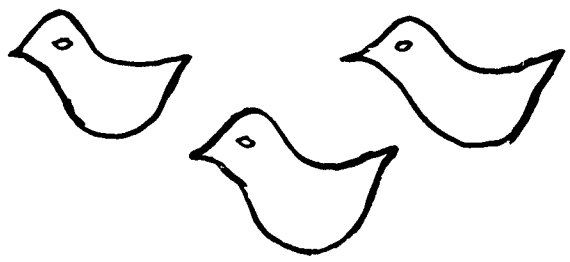
Embedded insects

III MIX AND MATCH

The class learns about three specific factors in camouflage - color, pattern and countershading - by sorting model birds to match them with various backgrounds.



Backgrounds and overlays

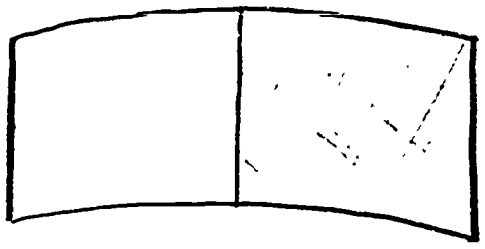


Magnetic model birds

IV "SAVE THE YANG OF YING"

The children try to countershade and pattern a mythical animal to match his environment.

Hemispheres "Yangs"

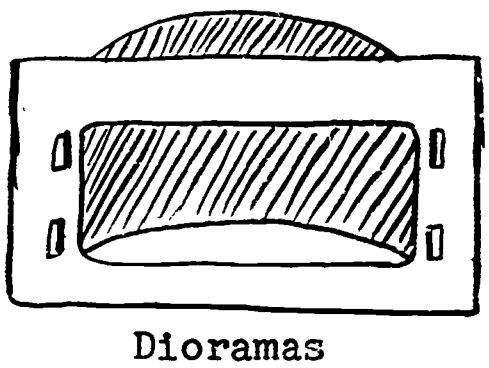


"Wallpaper" background

Colored chalk

V MAKING DIORAMAS

Each child receives a small cardboard replica of the Shadow Box. His task is to create both a background and an object to be camouflaged against that background.



Dioramas

A full inventory of the contents will be found inside the Box.

PREDATORS AND PREY

The Idea

This activity will introduce the children to the idea of camouflage and get them thinking about what it is that makes an animal difficult to see.

The activity has two parts. In the first the teacher sets up a camouflage situation and the children act as "predators" trying to locate the "prey". In the second part the children play among themselves a game which requires both good deception as hiders of "prey" and good detection as "predators".

The main concepts the children should learn from these activities are:

1. Camouflage depends on a particular relationship between the predator, the prey, and the background.

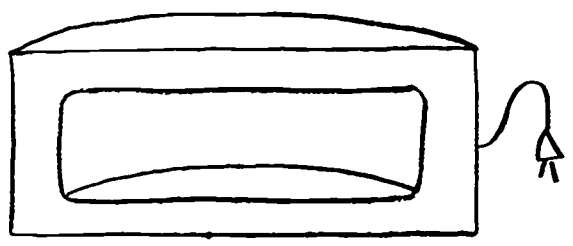
2. Color, pattern, and shape are important factors in this relationship.

3. Camouflage may not be perfect, but it does help animals survive better than they would without it.

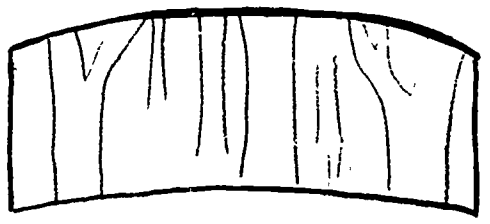
Part 1: The teacher sets up a woodland scene in the Shadow Box. The children try to detect a number of moths concealed in the scene.

How to proceed: Set up the scene in the Shadow Box before classtime so the children cannot observe the placement of the moths. Insert the woodland background. Place the moths in various spots by sticking them to the background with the magnets. Turn on the light but keep the Shadow Box covered until you are ready to use it.

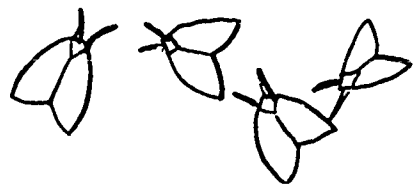
What you will need



Shadow Box



Oak forest background



Ten magnetic moths

Introduce the scene to the children by telling them it represents an oak forest in fall, with several large moths living on the trees and on the ground. These moths form an important part of the food of sparrow hawks, small "birds of prey" which hunt by day. Tell the children they will play the role of the sparrow hawks, but as these birds fly quite fast they will only have a short time in which to look at the scene. Let the children view it for three seconds, then turn it away from the class. Ask several children how many insects they saw, and if no one has seen them all, let the class view the scene again for three seconds, and ask them again how many moths there were. You can repeat this viewing and counting until the children are unable to see any more insects or until someone has seen the full number. Incidentally, if it is difficult for the children to locate the moths, it probably would be for the hawk, too.

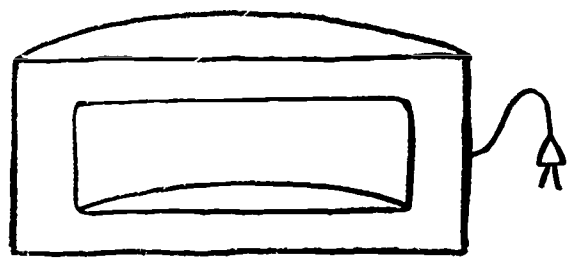
(You may want to repeat this first activity if the children do not immediately grasp the idea.)

Part 2: Small groups set up a scene in the Shadow Box. The rest of the class try to find the animals ("prey") they have concealed.

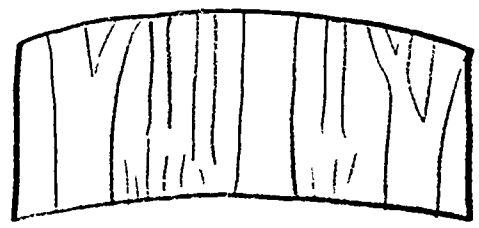
How to proceed: The class should be divided into groups of five or more to play the game. The number and size of the groups will depend on the time available, since each group will need about five minutes to set up the scene and let the rest of the class view it.

Give each group the name of a predator such as the Hawks, Owls, Weasels, Snakes, Foxes, Badgers, Raccoons, etc. Discussion

What you will need



Shadow Box



Oak forest background

Ten magnetic animals in bag

of the efficiency of the predators and the camouflaged animals (prey) will either follow the game or occur simultaneously.

To start the game: the Shadow Box should be turned with its back toward the class. Each group in turn gets together out of view of the rest of the class to decide how many animals ("prey") they wish to place in the scene. They may place any number from zero to five, but this number should vary with each group so that the "predators" at their seats will not know how many to look for. They should then draw the number of animals decided upon from the "grab bag", always keeping the number and the type of creatures they draw a secret from the rest of the class. Then they proceed to arrange them in the best positions for camouflage. When the scene is set, the Shadow Box is turned around to face the class.

Allow the same amount of time for viewing after each group has arranged its scene. After some time to talk it over among themselves, ask each group of "predators" to write on paper the number and names of animals they saw. Collect the paper from each group at the end of the round and record the information on the board in a form similar to that of the scoring sheet on the next page. While you are doing this, the next group could be picking out and arranging its "prey" animals in the Shadow Box. You could also ask the class while they are waiting to think up all the examples of camouflage they know.

Scoring: The "predators" receive one point if they have been able to see the right number of animals placed in the scene. They must give the exact number or no point is scored. If the number is correct, they may earn one additional point by naming all of the animals correctly, e.g. frog, snake, etc. This point is scored only if all of the animals placed in the scene are identified correctly. Hence, the highest score any "predator" group can earn in one round is two points. The group that set up the scene receives all points that are not earned by the "predator" groups. If there are four groups of "predators" a total of eight points is possible.

For an example of how a game might proceed, see the scoring sheet on the next page.

The Hawks had the first turn and decided to hide four animals, a frog, a snake, and two insects. As predators, the Owls, Foxes, and Weasels each got one point for seeing the right number of animals, but only the Snakes were able to name all the animals and so they got two points. The remaining three points in the round went to the Hawks.

The Owls' turn was next. With an insect and a frog they totally outwitted the Weasels, they lost one point to the Foxes, and lost two points to the Snakes and Hawks, so their score was 3.

GROUP HIDING ANIMALS	ANIMALS HIDDEN	POINTS EARNED BY "PREDATORS" OWLS	SNAKES	HAWKS	FOXES	WEASELS	TOTAL POINTS
HAWKS	Frog Snake 2 Insects	1	2	(3)	1	1	8
OWLS	Insect Frog	(3)	2	2	1	0	8
WEASELS	Snake Moth Frog Spider	0	1	1	0	(6)	8
SNAKES	Moth Frog	2	(1)	2	1	2	8
FOXES	Spider Snake Insect Spider	1	1	1	(5)	0	8
TOTALS		7	7	9	8	9	

Each group's total score is made up of the points earned both in concealing (figures in parentheses) and in detecting the "prey". Thus the scoring lends itself to an analysis of how well each group has done on each of these two tasks. In the above case, the Weasels were best at hiding animals and the Snakes and Hawks were best at detecting them.

ALL KINDS OF CAMOUFLAGE

The Idea

Because the MATCH Box can deal with only a limited number of situations, we have tried to illustrate the wide range of camouflage in the animal world through a set of color slides of animals in their natural surroundings. The children can learn much about camouflage directly from viewing the slides but if they want to know more about the animals, you will find a brief description of each slide at the end of this lesson plan.

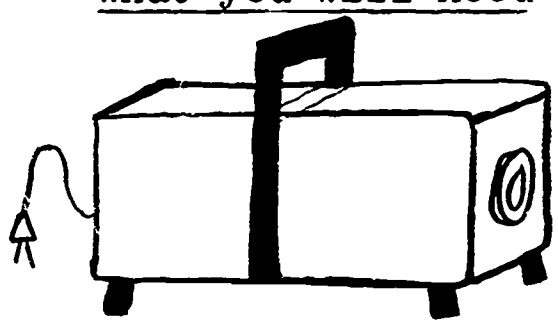
Some ways you can use the slides

1. To demonstrate the occurence of camouflage among animals of many kinds.

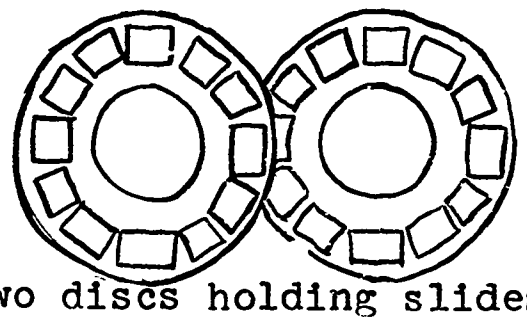
2. To focus on specific camouflage techniques. A table on the following page indicates which slides show countershading, color matching, pattern matching, disruptive patterning, and disguise.

3. To stimulate interest and provide ideas for the dioramas to be made by the children in Lesson IV.

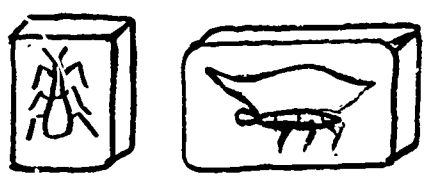
What you will need



Slide projector



Two discs holding slides



Two embedded insects

The slides can be used in an observation game, in which you show each slide for 3 seconds and then ask the children "What did you see?" or "How many animals did you see?"

CAMOUFLAGE TECHNIQUES IN COLOR SLIDES

SLIDE	ANIMAL	COUNTER-SHADING	COLOR-MATCHING	PATTERN MATCHING	DISRUPTIVE PATTERNING	DISGUISE
1	Praying mantis		■			grass
2	Trout	■		pebbles		
3	Tree frog			bark		
4	Horned lizard		■		■	desert rocks and plants
5	Vine snake		■			thin branch
6	Water snake				■	
7	Bittern					dead branch
8 9	Ptarmigan	■		tundra plants		
10	Prairie chicken	■		stubble		
11	Sanderling	■	■			
12	Piping plover		■		■	eggs as pebbles
13	Turnstone		■		■	
14 15	Woodcock			dead leaves		
16 17	Wood ducks				■	
18	Sparrow hawks			bark	■	
19	Night hawk			gravel		
20	Rabbit	■	■			
21	Deer	■	■		■	
22	Giraffe			sun and shade		
23	Weasel	*	■			
24	Tiger			dry grass	■	

* in summer

COLOR SLIDES

These brief descriptions do not attempt to give all the facts on any animal; they are merely to help you answer the questions which your class is most likely to ask. The camouflage shown in the slides may be for defense from predators or it may help in hunting for food.

1.
Praying mantis in the grass

This insect is found throughout the eastern United States, Europe, and China, living in bushes and smaller plants where it catches other insects by lying in wait and grabbing them with its hooked forelegs. In captivity, it may become a cannibal. A mantis may be up to 3 1/2 inches long, and green or brown in color. The mantis is camouflaged from both its prey and its enemies by its color and shape, which disguise it as part of a plant.

2.
Trout on the stony bed of a stream

This fish, a relative of the salmon, is found all over North America and Europe, and is popular with fishermen. It prefers to live in fresh water, cold or warm, still or running, but some species make long journeys to the ocean and back to fresh water to spawn. The trout eats insects, crustaceans and smaller fish. The trout's camouflage is due to the color and pattern of its spots, which match the dappled or pebbly bottoms of streams and ponds.

3.
Tree frog on bark

This small frog is found in the eastern United States and spends most of its time in trees standing in or near water, only coming to the ground to breed. It can be up to 2 inches long and has a warty skin but is not as rough as a toad. Like all frogs it eats worms, small crustaceans, and live insects of all kinds. The color pattern and texture of its skin closely match the bark on which it lives, protecting it from many predators.

4.
Horned lizards on dry desert soil

This horned lizard is found only in Australia. Although it is sometimes called a "horned toad" it is really a reptile and lays eggs with tough white shells. It lives in sandy, gravelly, or rocky desert areas and eats ants, which it catches with its sticky tongue, sometimes eating a thousand at one meal. It is a harmless animal which moves slowly and deliberately. The horned lizard is camouflaged by the orange, brown and white markings which match the ground colors, disrupt the animal's outline, and help, with its spines, to disguise it as a prickly desert plant or rock.

5.
Vine snake entwined in a bush

This harmless snake lives in trees and bushes in tropical South and Central America, eating birds' eggs, young birds, and insects. Its average length is 4 feet and it has a very long thin head, body, and tail. This shape, together with its green coloring, helps to disguise the snake as a thin branch or vine when it is hunting, and also protect it from birds of prey.

6.
Water snake on a log at the edge of a pond

This harmless snake is common near water throughout the northeast United States It is an excellent swimmer and always takes to the water when frightened. Its food includes frogs, fish, crayfish, and salamanders. This snake is camouflaged by the disruptive pattern of bands and stripes which help to break up the outline so that at first glance the shape is not clearly that of a snake.

7.
American bittern among reeds and pond weeds in a swamp

This bird lives in marshes and swamps throughout the eastern United States. It is rarely seen in trees but often stands very still with its bill pointing straight among the reeds where it nests. The bittern has a loud booming voice; it eats frogs, water insects, fish, voles, and mice. When standing in its typical pose, the bird's shape and color make it look like a broken branch sticking up out of the swamp.

8.
Female ptarmigan standing on a rock
9.
Female ptarmigan incubating on its nest

This game bird lives in the Arctic tundra, and on northern moors and mountains in North America and Europe, eating the leaves, twigs and fruit of moorland plants and coniferous trees. The plumage shows a seasonal color change: grey-brown in the summer and white in the winter. The color and pattern of the feathers match the plants or snow on tundra and moor; the bird has light countershading on its underside and flattens itself when on the nest, thus hiding its shadow.

10.
Prairie chicken in a grassy field

This game bird lives on prairies and brushy grassland on the Great Plains of the Midwest, where it eats the buds, leaves, twigs, and seeds of many plants, including some farm crops. It is camouflaged by being countershaded, and the streaks and bars of its plumage match the grass and stubble on which it lives.

11.
Sanderling on a sandy beach among pebbles and shells, in winter

This is a shore bird which lives on sandy beaches and sand flats in the Arctic in the summer, and along the Northeast and Northwest coasts of the United States in winter. It eats worms, crustaceans, and shellfish for which it probes in the sand with its long bill. The color and pattern of the bird's feathers match the sand, shells, and pebbles of the shore. The coloring changes from rusty in the summer to whitish in winter.

12.
Piping plover sitting on eggs on a stony beach

This small shore bird is found on beaches and sand flats along the Northeast coast in the summer, and along the Southeast coast in winter. Its food is the tiny shellfish, crustaceans, and worms in the sand. The bird is camouflaged by its color which matches the dry sun-bleached sand and pebbles. The disruptive black and white pattern breaks up the outline, and the eggs look like pebbles.

13.
Ruddy turnstone incubating among tundra mosses and lichens

In the summer this shore bird lives near water and among Arctic tundra plants. In the winter it can be found on pebbly beaches, salt flats, and seaweed-covered rocks along the Northeast and Northwest coasts of the United States. It eats shore crustaceans, shellfish, worms, and insects. The "harlequin" pattern of red, black, and white matches the tundra mosses in the Arctic and forms a bold disruptive pattern to break up the bird's outline, especially as seen from above when flying.

14.
Woodcock incubating on a woodland floor
15.
Woodcock incubating - closeup

This stumpy, long-billed game bird is found in woods, fields, swamps, and thickets all over the eastern United States. It digs for worms and insects in the soil with its narrow bill. The "dead leaf" pattern of its plumage closely matches the woodland floor on which it nests.

16.
Male and female wood ducks on the open water of a pond
17.
Two male wood ducks and one female in brush at the edge of a pond

The wood duck is found in wooded swamps and on the banks of tree-lined ponds, streams, and rivers all over the United States. Unlike most ducks, it builds its nest in hollow trees, well above the ground. It eats water insects, small fish, and water weeds. The bold disruptive patterning of the male duck is clearly seen on open water, but on shaded water and among plants at the water's edge it breaks up the bird's outline. The female has inconspicuous coloring.

18.
Two young sparrow hawks at the entrance to their nest in a tree

This is the smallest North American hawk and it lives in woodland, open country, and in gardens all over the United States. It likes to sit very

upright on dead trees and telegraph poles, occasionally bobbing its head and jerking its tail. When hunting for its food, mainly large insects and mice, it hovers above the ground. The male and female birds have different colorings - the male is slate grey on the back and the female rusty red. The young birds have feathers colored and patterned to match the tree bark; the adults have disruptive patterning.

19.
Nighthawk roosting on a gravel roof

This bird is not really a hawk at all, but a relative of the "whipoorwill". It can be seen anywhere in the United States in summer, and migrates to South America in the winter. It flies high over cities on summer evenings, hunting for mosquitoes, moths, and flies. During the day it roosts on roof tops. Because of the color and pattern of its feathers, it is well-camouflaged on the gravel of house tops.

20.
Two cottontail rabbits at the edge of a field of cut corn and pumpkins

The cottontail is common all over the United States in fields, woods and swamps. It eats the bark, leaves, and twigs of many kinds of plants, including farm and garden crops. The rabbit's fur matches the soil, and it is countershaded by the lighter colored fur underneath.

21.
White-tailed deer in grass at the edge of a wood

These deer are found everywhere in the United States except the Pacific coast. They are most common in eastern woodlands, especially at the edges of woods, orchards, and farmland. They eat twigs, leaves, and bark of many kinds of trees and shrubs. The brown coat matches the dry grass and is lighter on the underside, while the black and white markings at the tail confuse the animal's outline in the sun and shade of a wood.

22.
Giraffe among acacia trees in Kenya

The giraffe is found in the hot, dry, brush country of East, Central, and South Africa, where it browses on the upper leaves of acacia and mimosa trees. The average height of the adult is 16 feet, but it has the same number (7) of neck bones as any other mammal. To reach the water or lower leaves of trees, it spreads its forelegs apart. It can run as fast as 30 miles per hour. The patches of light and dark color in the giraffe's coat match the pattern of sun and shadow among the leaves.

23.
Weasel in the snow

This is a bloodthirsty, vicious hunter, living in forests, fields and hedges throughout North America and Europe. It hunts mice, rats, rabbits, squirrels, and game birds, often killing more than it can eat. Although very quick, it is curious and easily trapped; its winter fur is known as ermine. The weasel's fur provides good color matching - white in the winter and brown with countershading in the summer. It always keeps the black tip to its tail.

24.
Indian tiger in long grass

The most powerful member of the cat family is found in most parts of Southeast Asia, China, and Siberia. It lives in jungles and grassland, hunting big game animals - deer, antelope, wild pigs, and cattle. The tiger may reach a weight of 500 pounds and a length of 12 feet. When hunting, the tiger is well-camouflaged by the striped pattern of its fur which matches the long grass and helps to break up the animal's outline.

MIX AND MATCH

The Idea

In this lesson, the children are introduced to three specific elements of camouflage - color, pattern, and countershading - through a series of sorting tasks directed by the teacher. The children are then asked to use what they have learned in constructing a well-camouflaged scene in the Shadow Box.

How to proceed: The exact procedure is not important here, as long as the activity develops three major concepts:

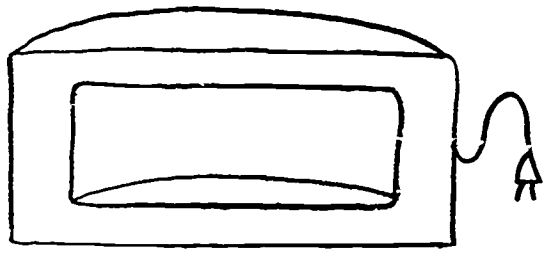
1. Color is an important factor in concealment

2. Patterning in general makes camouflage effective by breaking up outlines; a specific pattern may increase the effectiveness

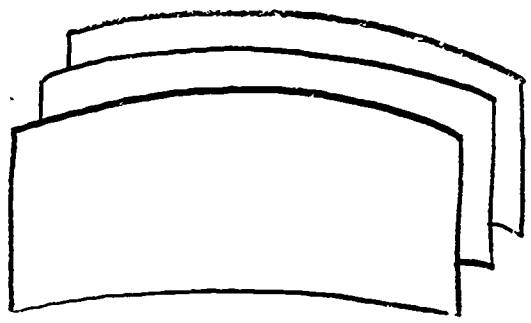
3. Countershading increases the effectiveness of camouflage by helping to offset the tell-tale shadow caused by light from above and by making a solid object look flat.

In the suggested procedure which we outline below, each set of steps emphasises one specific concept and leads in sequence to the next.

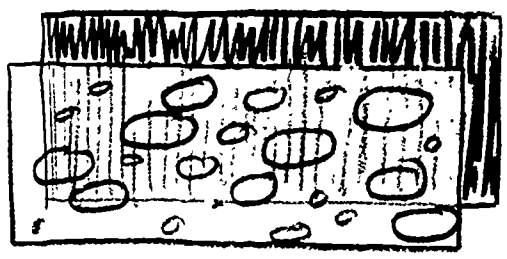
What you will need



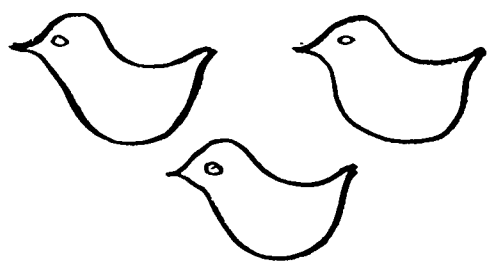
Shadow Box



Three plain backgrounds



Two overlays



36 magnetic model birds

Stage 1 - to emphasise color: Place about 20 mixed model birds on the background (A) outside the Shadow Box in full view of the class. Ask volunteers to pick out the birds which are easiest to see against this background. Encourage a variety of choices for a variety of reasons. (Some birds may be chosen because their color is different, others because they are patterned, not plain like the background. Much discussion is in order here.)

Stage 2 - to emphasise general patterning and specific patterns: Remove the remaining birds from background A and let someone choose an overlay to place over it. Again place a mixed lot of birds on the background and ask volunteers to pick out the ones which are easiest to see on the new patterned background. (They may choose birds that have no pattern at all, or birds which do not have the same pattern or color as the background.)

Now ask someone to take away <u>all</u> the patterned birds which do not seem as well concealed as the others. Note the reasons why they are easier to see. (Birds with the same pattern match the background better than those that are very different from the overlay.)

You might try switching the background color for a moment, simply as a means of re-emphasizing the color factor. Return to background A for the next stage.

Stage 3 - to emphasise countershading: Place background A and the "Rock" overlay in the Shadow Box. Since it is now obvious that both color and pattern are important, have someone select birds of the same color and the same specific pattern to blend well with the overlay. Note any differences among these birds besides that of pattern. (Some have countershading - the underside is lighter. Some are flat, not solid.)

See if the children can determine how the lighting in the Shadow Box may help to show the birds in a more "real" light. (In the Box, stronger light, like that of the sun in nature, comes from above. Outside the Box, a scene is lit more equally from all sides.)

Let the class consider whether the 3-dimensional solid or the flat birds are harder to see in the Box, and why. (The 3-dimensional birds will be less well-concealed, yet this is the natural form of most animals. Hence the problem created by the tell-tale shadow!)

Now consider only the 3-dimensional birds, since these are the natural form. Have someone pick out the birds which stand out because they have a darker, shadowed underside in the strong top-lighting of the Box. (Only those which have countershading will now be well-concealed, since this effect helps to balance the light from above.)

After the class has had the opportunity to consider and sort a number of times in this way, divide the entire group into three teams. Assign or let each team choose one of the backgrounds. Each team should then have a turn to choose the overlay and one or two birds which it thinks will make the best camouflaged scene in the Shadow Box. They should then set up the scene, letting the rest of the class evaluate it and suggest alternatives which they might have used.

You may feel your class would benefit from arriving at an awareness of these three elements of camouflage in a less structured way, perhaps by experimenting on their own. By all means fit the approach and use of the materials to the particular requirements of your class.

SAVE THE YANG OF YING

The Idea

Up to now, the children have been dealing with existing camouflage situations and gaining insight into some of the underlying principles of camouflage. In this activity they do the camouflaging and apply some of the principles that they have encountered in previous activities. They will be dealing with two techniques of camouflage - countershading and pattern-matching. Their task will be to camouflage an imaginary animal ("Yang") against a matching plain background and then against a patterned background. This task is introduced by the "myth" which presents the predicament of the "Yang of Ying"!

How to get started:

Introduce the activity by telling the children that they are to use all they know about camouflage to help an animal out of a "terrible situation".

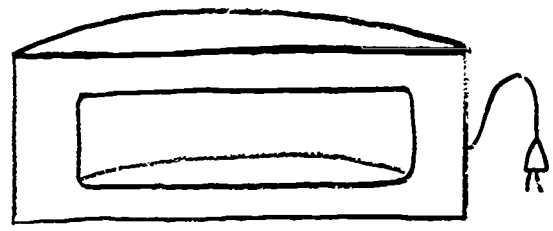
Tell or read "The Tale of the Yang of Ying". Pose the problems as suggested by the story - how did the Keepers color the Yang so that it would not be seen on the plain walls of its room when the light was turned on, and, later, how did they match it to the patterned walls in the King of Murk's palace?

Show the split background with the two wallpapers in the Shadow Box. Be sure all lights in the box are turned on throughout this activity.

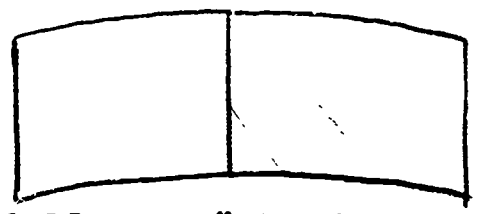
Pass out the hemispheres, representing the "Yangs" - one to each child. Give the class brief

What you will need

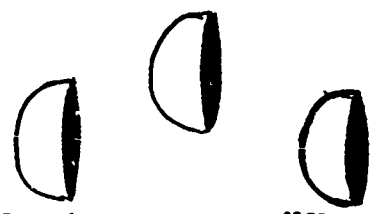
From the Box:



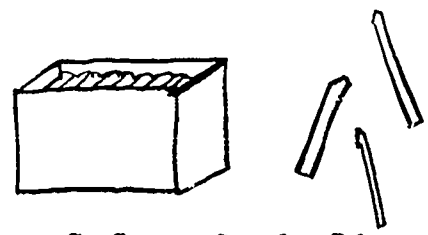
Shadow Box



"Wallpaper" background



Hemispheres "Yangs"



Colored chalk

From the classroom:

White chalk

instructions on how to proceed with the countershading and patterning:

1. Point out that the "Yang's" color matches that of the plain wallpaper in the Shadow Box. Each child's problem is to lighten the underside of his animal so as to compensate for the shading which results from the top-lighting. This lightening can be done by subtle coloring of the "underside" of the "Yang" with white chalk, just like an animal's underside is lighter in nature.

2. When the children have countershaded their "Yangs", they should then proceed to add a pattern to match the patterned wallpaper to the topside of their animals, repeating it more lightly on the underside.

3. The "Yangs" will slip over the magnetic hooks which stick to the background in any position. Encourage the children to come up to the Shadow Box to help them see what effect their coloring has had, and what more might be needed. Check to see that they all understand which part of their hemisphere is to be shaded. The chalk is easily rubbed off if mistakes occur.

4. Some children might try turning their "Yangs" upside-down to see what effect this has on the appearance of the animal against the wallpaper. Other problems for trial and discussion may present themselves as the activity progresses.

   If there is time and interest, encourage experimentation with various degrees and combinations of patterning and shading.

THE TALE OF THE YANG OF YING

Once upon a time, in the Land of Ying, there lived a very Good King. He ruled his kingdom well, and his people were happy. You see, the King was what you would call basically content, and the reason was that he had a very special creature called a Yang which had magical powers and brought him luck. If the king made sure to give his Yang a little rub each day, then he felt good and at peace with himself and was able to make wise decisions for the people of Ying.

There was a terrible time many years ago, that the people of Ying don't even like to talk about, when the Yang was lost for a whole week! A kind of grouchiness spread through the land -- people started arguing with each other, and complaining about their aches, and they got real stingy with their things and their ideas. But finally, on the seventh day, when people were ready to scratch and punch each other, the Yang was found in a pile of grapefruit in one of the king's own kitchens. You see, in those days the Yang was yellow and it had fallen into a basket of grapefruit where no-one noticed it. It was the quick thinking of Olga, the cook, that saved the day. No one but the king had ever seen the Yang before, but when Olga saw what looked like half a grapefruit walking across the floor, she got suspicious and reported it to the authorities. They, in turn, reported to the king, who dashed to Olga's kitchen.

He rubbed the Yang very quickly and hard and, though it made a kind of grumbling noise, order and joy immediately began to spread through the kingdom once more. Ever since that time, the 72nd of Klonkter has been known as Grapefruit Day, the biggest holiday of the year. Some people also celebrate it as St. Olga's Day.

Then the king appointed the thirty wisest and cleverest men in the kingdom to be Keepers of the Yang. Their job was to protect the Yang at all times. One of the things they did was to make a special room which was all blue, and they painted the Yang blue so that it would be very hard to find. The Yang was so hard to see that one of the Keepers did nothing but keep his eye on it. He was called the Watcher.

Each morning, when the king came into the Yang's room to pet it, he would ask the Watcher to show him where it was, and then he would say,

"Yang, oh Yang upon the wall,
Let me rub you so that I and all
Will have good luck and no harm will befall
The happy kingdom of Ying at all."

Then the king would rub his hand over the round back of the Yang which would make a little noise meaning that it felt good, too.

Now there were several other kings who ruled the countries around Ying and who envied the luck the Yang brought to its owner. These jealous kings were always plotting to find the Yang and to take it for their own. The king of Murk one day devised a plan to get the Yang. He sent

two spies to Ying, two very crafty fellows who were able to make their way into the castle grounds and to climb up a wall outside the palace. They finally found the blue room which they thought must have something to do with the Yang, and they peeked through the windows, but no matter how much they looked they could not see anything unusual. They could see the Watcher, but he was standing quite still and just staring straight ahead so they thought he was just one of the palace guards. "Perhaps we have found the wrong room," they thought, but they decided to wait and see whether someone would come into the room. When night fell and it got real dark they were still looking into the room, and soon they saw another keeper come in and turn on the lights. Again the spies looked carefully into the room, and this time they saw the Yang. "That must be it", they whispered excitedly, as they saw a small round object on the wall the Watcher was watching. "So that's what the Yang looks like. It is small and round and blue and it lives on the walls of the room." They started speaking so loudly in their excitement that the Watcher heard them, and without taking his eyes off the Yang, he gave the alarm. Palace guards came running. The two spies scrambled down the wall and started to run across the gardens to get away, but one of them, the short ugly one, tripped and fell and was caught by the palace guards, while the other escaped over the wall and made his way back to the king of Murk.

The spy who was caught was brought before the King of Ying and the Keepers, who decided that torture was needed to make him tell where he had come from and what he had found out. As it turned out, only a trifle of torture was needed to make the spy confess that he came from the kingdom of Murk and that he had seen the Yang on the wall because of its shadow, and now he knew that it was blue.

Now the Keepers got busy to figure out a way to hide the Yang so that it would not show up in the evening when the light was turned on.

In the meantime, the tall skinny spy who had escaped got back to Murk and told his story to the king, who had a bright idea. He invited the king of Ying and all his advisers to come for a state visit. He knew that the king would never leave his Yang behind, so if he once got it into his own kingdom maybe he would have a better chance to steal it.

The king of Ying accepted the very kind invitation, even though he suspected what its real purpose was. He knew that the visit would probably be a trap, but he and the Keepers of the Yang felt it would be safest to take the Yang along with them.

When they arrived at the palace of Murk, the king of Ying and all his advisers were ushered into a very special room with the most fantastically patterned wallpaper you can possibly imagine. The minute they saw this, the Keepers knew what the trap was and that they didn't have much time. They

quickly got busy trying to color the Yang with special paints they carried with them so that it would not show up against these patterned walls. A few minutes later the king of Murk and a whole bunch of guards and soldiers burst into the room and started to search for the Yang. They looked all over, they looked under the beds and in the closets and along the walls, but the keepers had done such a good job that no-one could find the Yang.

After that, the state visit of the king of Ying was cordial but really not very pleasant, so the king of Ying soon went back to his own kingdom taking his Yang along of course. However, the king of Murk was not to be outdone. He sent one of his henchmen, disguised as a Keeper to mingle with the real Keepers on the trip back to Ying. When all the Keepers got back to the palace, they immediately took the Yang back to the blue room for safe keeping. But what do you think happened? The minute the Yang was put up against the plain blue walls, the fraudulent Keeper rushed forward, grabbed it and ran out of the palace back to the kingdom of Murk. All the king's Keepers and all the king's guards immediately gave chase, but the Watcher called them back. "Wait!" he said. "Let him go. He doesn't have the real Yang, I do!" And with that, he drew the real Yang from his cloak, and placed it on the wall. Everyone said, "Aah!" The clever Watcher said, "Gentlemen, you have just seen a practical demonstration of the decoy technique." He gave a very slight bow and everyone said a long and respectful "Ohhh."

MAKING DIORAMAS

The Idea

By now the children are well acquainted with the Shadow Box and they probably have a good sense of some of the more common principles of camouflage. Making their own dioramas will enable them to put some of these ideas to work.

The dioramas may be simply or painstakingly made, each child working in his own way. The only important question is how well the children can camouflage a 3-dimensional object. Once the dioramas are finished, they can be judged by the child himself or by the class. The whole point of this activity is to give the children as free an opportunity as possible to grapple with the "whole" of a camouflage problem, to work with as many techniques as possible and to see how they interact.

How to get started:

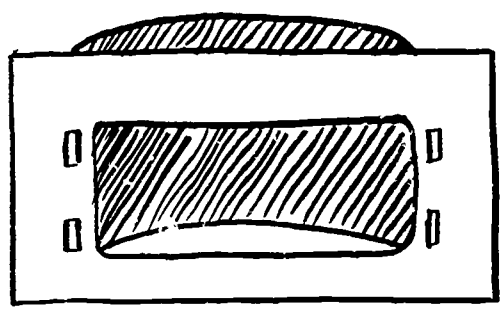
Pass out the dioramas and let the children assemble them. When put together they will resemble the Shadow Box.

Explain to the children that their task will be to camouflage some 3-dimensional object against the background of the dicrama. The objects to be camouflaged might be toys, objects taken from the classroom such as blocks, or anything else they might want to use. In planning for this activity, you could encourage the children to bring things from home.

The background, too, can be varied. The important thing is the relationship between object and background. We recommend

What you will need

From the Box:



Dioramas
(one for each child)

From the classroom:
manila paper for backgrounds

crayons, paints or chalk

3-dimensional objects brought by the children or taken from the classroom

odds and ends for backgrounds, such as twigs, old magazines, felt, cloth, yarn, wallpaper, etc.

that the backgrounds be made on separate manila sheets cut to the same size as the back of the dioramas (7 1/2 x 14) and then inserted in the diorama, rather than coloring the back itself. This will make it much easier for the children to work on the backgrounds and to change them when things aren't turning out just right.

Some children may want to cut background pictures out of magazines and then work on creating an appropriate object. Some may want to introduce foliage. The only restriction on this should be that they cannot simply hide their object behind something else.

Since the children may keep their dioramas, encourage them to use them any way they want. They can construct things inside, attach things to the floor or back, mount things through the back, etc. In short, let them have freedom in choice and construction.

When the dioramas are completed, have the children set them up so that the class can look at them from a distance. The class can judge how well the object was camouflaged and what techniques were used to get the effect. Some may wish to compose their own story around the scene in their diorama.

Since the dioramas do not have to be returned, they can be started or completed after the Camouflage Box has been sent back to the Children's Museum.

FILMS, FILM LOOPS AND FILMSTRIPS

FILMS ON PROTECTION, INCLUDING CAMOUFLAGE (16mm sound)

How Animals Defend Themselves	McGraw-Hill
Animals Protect Themselves	Coronet
How Nature Protects Animals	Encyclopedia Britannica Films

FILMS ON CAMOUFLAGE IN GENERAL (16mm sound)

Camouflage in Nature through Form and Color Matching	Coronet
Camouflage in Nature through Pattern Matching	Coronet

FILMS SHOWING PARTICULAR EXAMPLES OF CAMOUFLAGE (16mm sound)

Life in the Grasslands	E.B.F.
Life in the Desert	E.B.F.
Butterfly Mystery	Moody Institute of Science

FILM LOOPS (8mm silent)

Animal Camouflage: Insects	Ealing Corporation
Warning Coloration and Behavior: Insects	Ealing Corporation
Nature's Use of Color	International Communications Foundation
Colors are Useful	I.C.F.

FILMSTRIPS

Rainbow Realm of Tropical Insects	Life Filmstrips
Forests of Tropical America	E.B.F. Filmstrips
The Arctic Wilderness	E.B.F. Filmstrips

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REFERENCE BOOKS FOR THE TEACHER

Hugh B. Cott — Adaptive Coloration in Animals
Methuen, 1957
(An exhaustive account of all aspects of camouflage)

Adolf Portmann — Animal Camouflage
Ann Arbor Science Series, 1959
(A fairly good outline of the topic)

C. H. R. Chesney — The Art of Camouflage
Studio Publications - Transatlantic Art, Inc. 1943

Eric Sloane — Camouflage Simplified

R. P. Breckenridge — Modern Camouflage
Farrar and Rinehart, 1942
(These three books deal mainly with wartime camouflage of buildings, vehicles, etc., but make an interesting contrast with the first two.)

Life Nature Library (various authors) — Mammals; Birds; Reptiles; Fishes; Insects; Animal Behavior; Ecology; Evolution; etc.
(These books have many excellent illustrations and show examples of all kinds of camouflage.)

CHILDREN'S BOOKS

K. V. Nespojohn — Animal Eyes
Prentice-Hall

Edith Raskin — Watchers, Pursuers, and Masqueraders
McGraw-Hill

S. A. Lavine — Wonders of Animal Disguises
Dodd, Mead

C. P. May — When Animals Change Colors
Holiday House

ACKNOWLEDGMENTS

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ABOUT THE MATCH BOX PROJECT

In June, 1964, under a contract with the United States Office of Education, we started the MATCH Box Project at the Children's Museum. The term "MATCH" stands for Materials and Activities for Teachers and CHildren. A MATCH Box contains materials, equipment, supplies and activities that work together to foster the teaching/learning of specific subjects at the elementary school level. The Boxes contain a high proportion of real objects and require little or no auxiliary equipment or supplies from the school. In every Box there is a Teacher's Guide which serves to organize and activate the three-way encounter between the materials, the teacher and the children.

MATCH Boxes are designed for the relatively intensive treatment of a subject over two weeks, and can be circulated among teachers through material resource centers, libraries, museums, AV departments.

As the Boxes are being developed, materials and activities are tried out in the schools. Prototypes are then assembled, evaluated in local classrooms, and revised prior to distribution.

The first five MATCH Boxes, completed in September, 1965, were: GROUPING BIRDS (Grades K-2); THE CITY (1-3); THE ALGONQUINS (3,4); SEEDS (3,4); and A HOUSE OF ANCIENT GREECE (5,6).

The Box described in this guide is one of a second "generation" of Boxes completed in September, 1966: HOUSES (Grades 1-3); ANIMAL CAMOUFLAGE (2,3); NETSILIK ESKIMOS (3,4); MUSICAL SOUNDS AND SHAPES (3,4); ROCKS (5,6); JAPANESE FAMILY 1966 (5,6); and MEDIEVAL PEOPLE (5,6).

A third generation of Boxes will be finished in September, 1967.

Though the Boxes are our most tangible product, we use them and the developmental process itself as a method for studying the role that real materials play in teaching and learning, and as a way of seeking principles by which media may be combined to create effective educational systems.

This Box and this guide are prototypes and will be revised. We welcome your comments and criticisms. Please write to the MATCH Box Project, The Children's Museum, 60 Burroughs Street, Boston, Massachusetts 02130.

Fred H. Kresse
Project Director